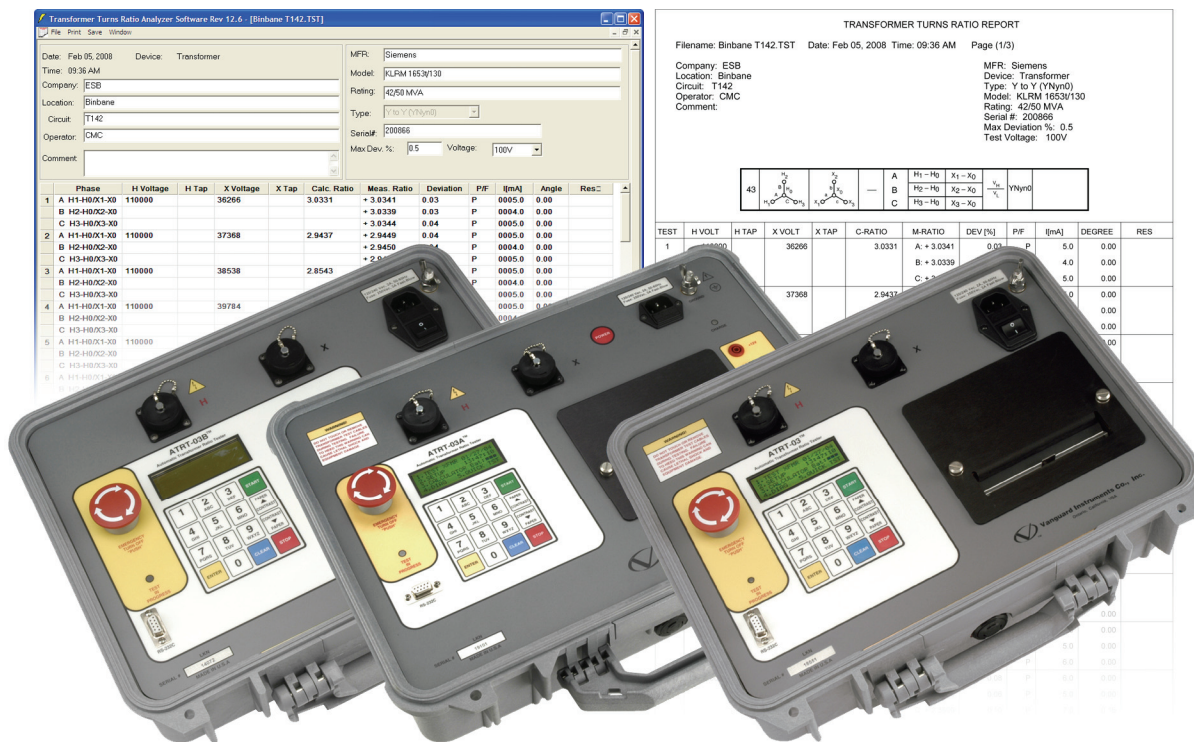


Transformer Turns Ratio Analyzer (TTRA)

VERSION 12.x SOFTWARE MANUAL

For Use with Vanguard's
ATRT-01, ATRT-03, ATRT-03A, and ATRT-03B
Transformer Turns-Ratio Meters



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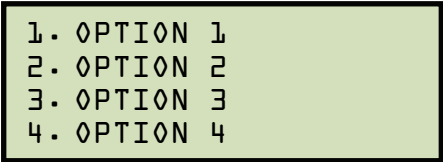
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CONVENTIONS USED IN THIS DOCUMENT

This document uses the following conventions:

- Microsoft® Windows XP and Vista will be simply referred to as Windows in this manual
- The general term “ATRT” used in this manual refers to any of the TTRA compatible Vanguard transformer turns-ratio meters (ATRT-03, ATRT-03A, ATRT-03B)
- Menu names are referred to as ***Menu Name***
- Menu items are referred to as *Menu Item*
- Dialog boxes and their elements (buttons, options, etc.) are referred to as “Dialog Box Element”
- PC keyboard keys are referred to as **[Key]**. Key combinations are shown as **[Key]+[Key]**.
- A key or switch on the ATRT is indicated as **[KEY]**
- File locations, directories, and filenames are shown as “C:\folder\filename”
- ATRT menu options are referenced as (*MENU OPTION*)
- An ATRT’s LCD screen output is shown as:



```
1. OPTION 1
2. OPTION 2
3. OPTION 3
4. OPTION 4
```

- Warning messages are indicated as:



Warning message

WARNING

- Important notes are indicated as:



Note details

NOTE

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1.0 INTRODUCTION

The Transformer Turns Ratio Analyzer (TTRA) software is a Windows-based PC software application for use with Vanguard's ATRT-03 line of three-phase transformer turns-ratio testers (ATRT-03, ATRT-03A, and ATRT-03B). This software allows users to perform the following tasks:

- Test winding turns-ratios of transformers, voltage regulators, and load-tap changers directly from a PC.
- Create test plans for transformers, voltage regulators, and load-tap changers.
 - The test plan can be created on the PC and then transferred to the ATRT.
 - A test plan can be used to quickly test transformers and obtain test results, percentage-error calculation, and Pass/Fail results.
- Export test records in Microsoft Excel format.
- Retrieve test records stored in an ATRT.

1.1 System Requirements

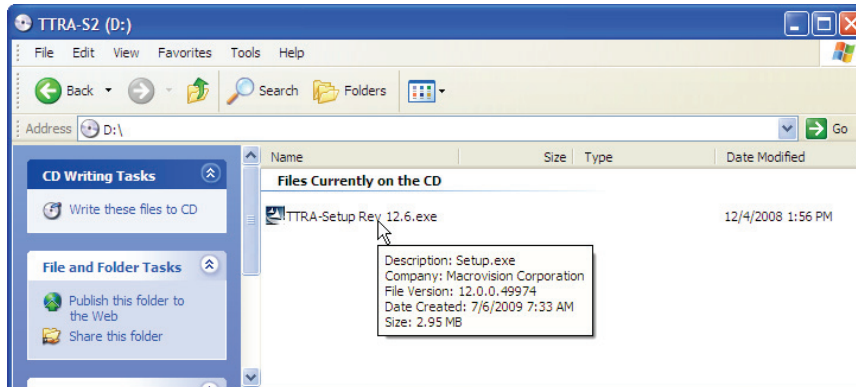
The TTRA software has the following minimum system requirements:

- PC running Microsoft® Windows® XP or Windows® Vista
- 2 Megabytes of hard drive space
- CD-ROM or DVD-ROM drive
- RS-232C (serial) port

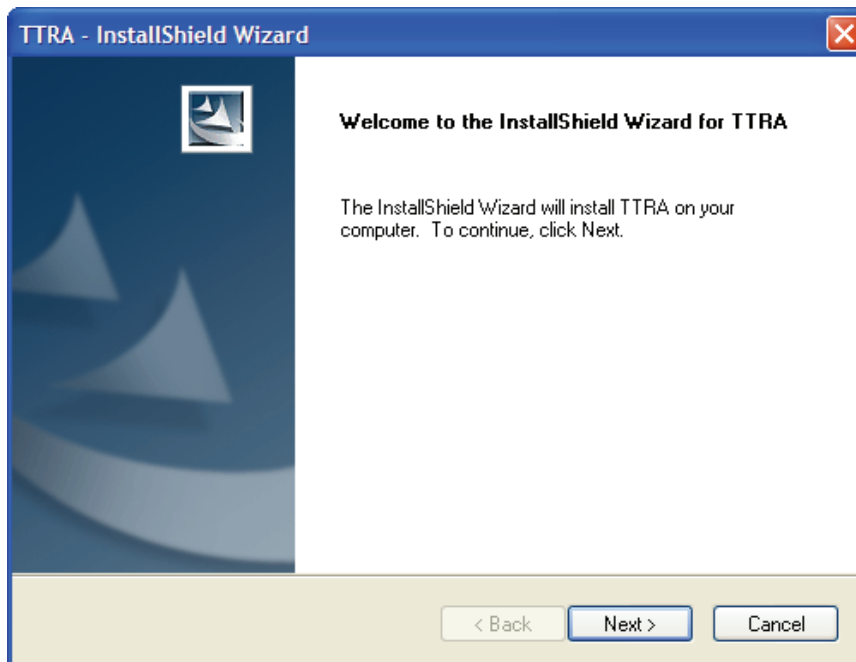
2.0 SOFTWARE INSTALLATION

Follow the steps below to install the TTRA software on your PC.

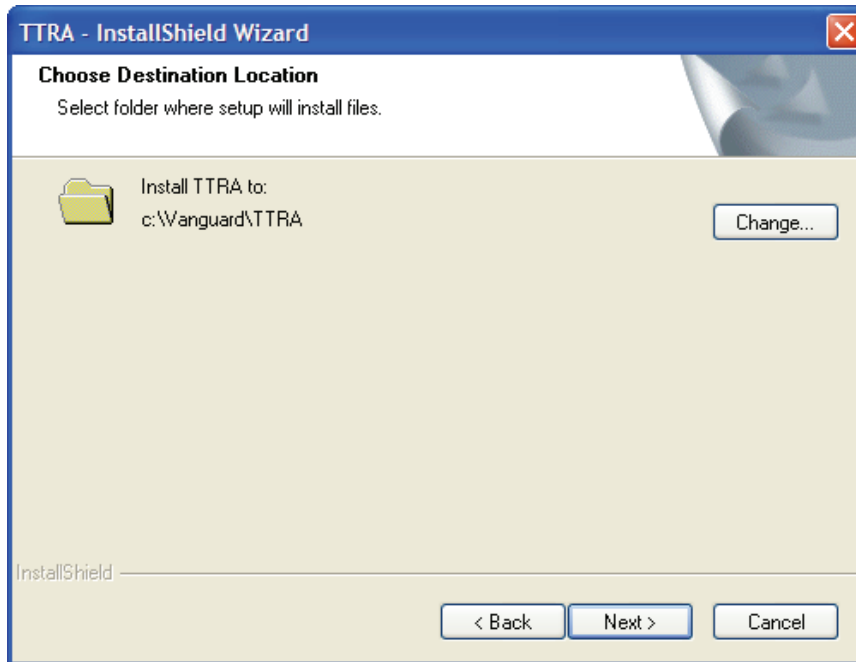
1. Insert the installation CD in the PC's CD or DVD drive.
2. From the Windows Desktop, click on the "Start" button to bring up the **Start Menu**.
3. From the **Start Menu**, click on *My Computer* to open the My Computer window.
4. Double click (or single click in some Windows configurations) on your CD/DVD Drive icon to navigate the installation CD. The contents of the CD will be listed as shown below:



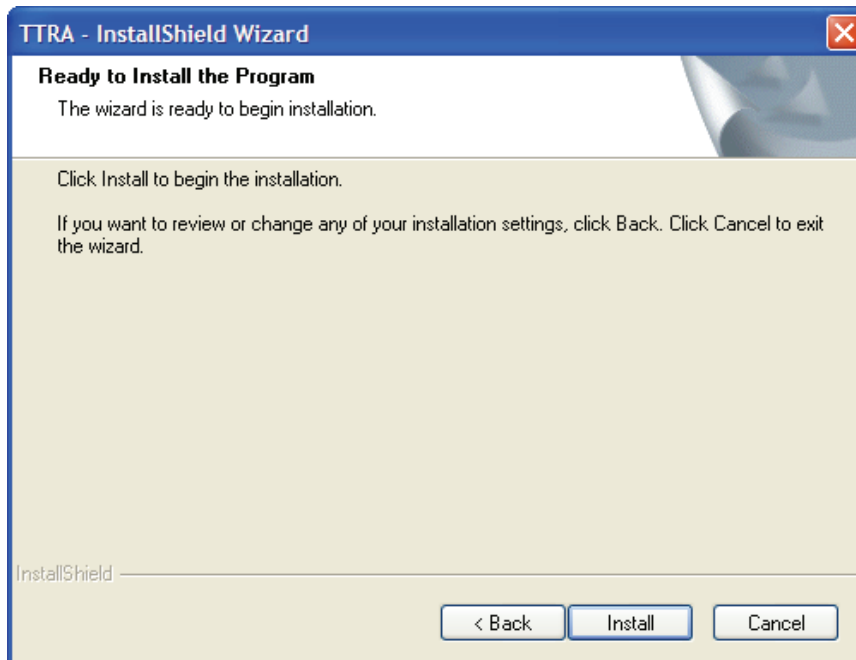
5. Double click (or single click in some Windows configurations) on the "TTRA setup Rev 12.x.exe" file to start the installation process. The TTRA InstallShield Wizard will appear as shown below:



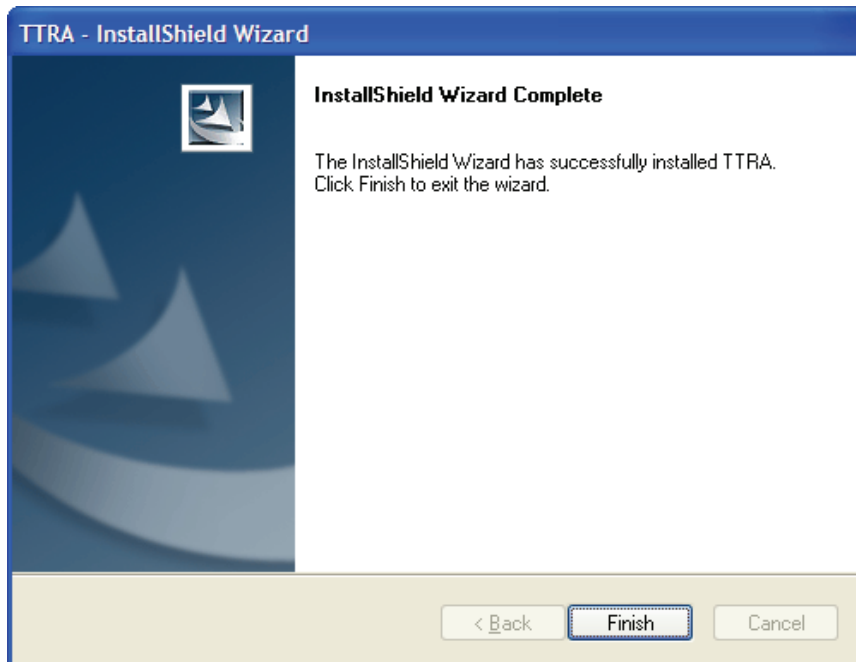
- Click on the “Next” button to continue. The following screen will be displayed showing the location on your hard drive where the software will be installed (C:\Vanguard\TTRA):



- You may choose a different installation location by clicking on the “Change...” button and then browsing to the location on your hard drive where you would like to install the software. If you would like to install the software in the default location, click on the “Next” button to continue. The following screen will be displayed:



8. Click on the “Install” button. The InstallShield Wizard will copy files to your hard drive. The following screen will be displayed once the software has been successfully installed:



9. Click on the “Finish” button to close the InstallShield Wizard and complete the installation process.

**NOTES**

- The installation program will create two sub-folders, “*Test Plans*” and “*Test Records*”, in the main installation folder. By default all test records will be stored in the “*Test Records*” folder and all test plans will be stored in the “*Test Plans*” folder.
- You can later change the default test record and test plan storage locations. Please see section 3.2 for details.

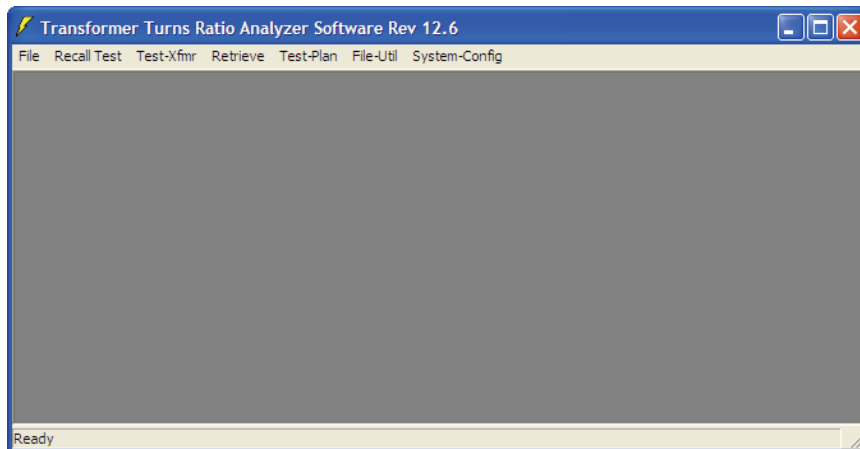
3.0 STARTING AND CONFIGURING THE TTRA SOFTWARE

During the installation process, a Vanguard program group will be created under the *All Programs* submenu in the Windows **Start** menu. To launch the TTRA software:

**NOTE**

You can create a shortcut on your desktop to speed up the application launching process. Please see the Microsoft Windows Help and Support Center (can be accessed by pressing the F1 key when viewing the Windows desktop) for information on how to create shortcuts.

1. Click on the Windows “Start” menu button to open the **Start Menu**.
2. Click on the *All Programs* menu item.
3. Click on the *Vanguard* menu item.
4. Click on the *TTRA* menu item.
5. Click on the **LAUNCH TTRA** menu item. The TTRA main application window will appear as shown below:

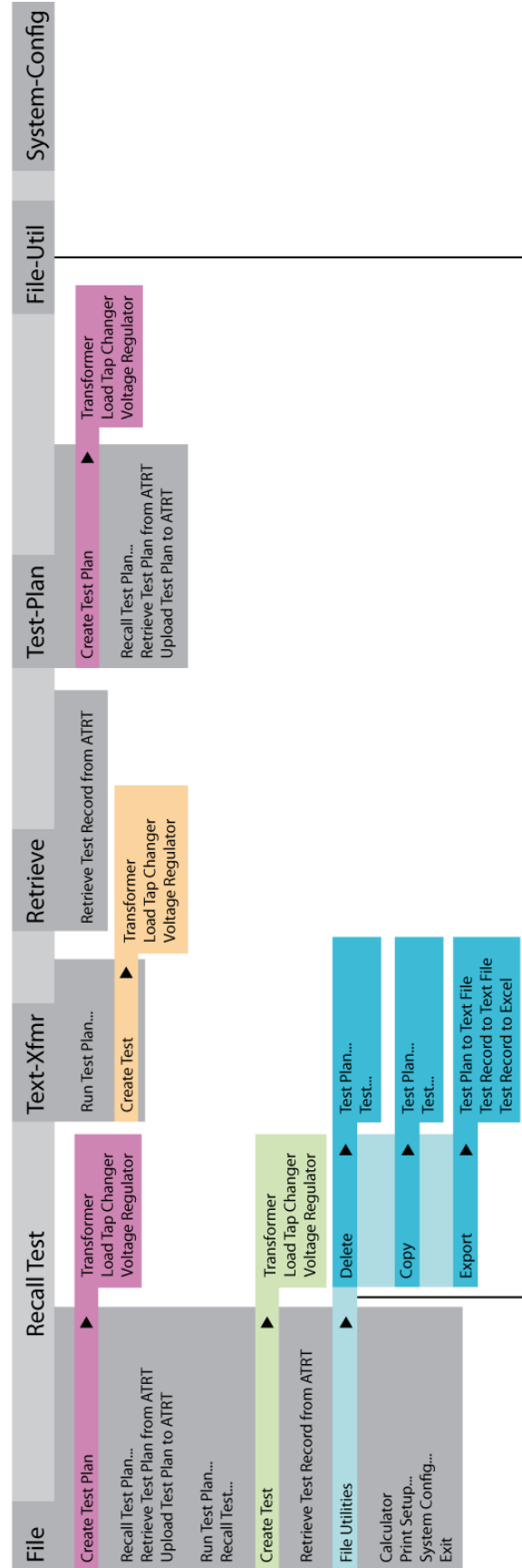


3.1 Main Menu Item Descriptions

The TTRA Main Menu bar features the following menus:

- **File Menu:**
 - Create, transfer, and run test plans
 - Create and retrieve tests
 - Configure system parameters and options
 - Use various file utilities
 - Use turns-ratio calculator
 - Exit the program
- **Recall Test Menu:** Recall test records from the PC hard drive for viewing
- **Test-Xfmr Menu:**
 - Run a test plan
 - Create a transformer, load tap changer, or voltage regulator test plan
- **Retrieve:** Retrieve test records from an ATRT
- **Test-Plan:** Create, retrieve, modify, transfer, and export test plans
- **File-Util:** Copy, delete, and export test records and test plans
- **Sys-Config:** Configure system parameters

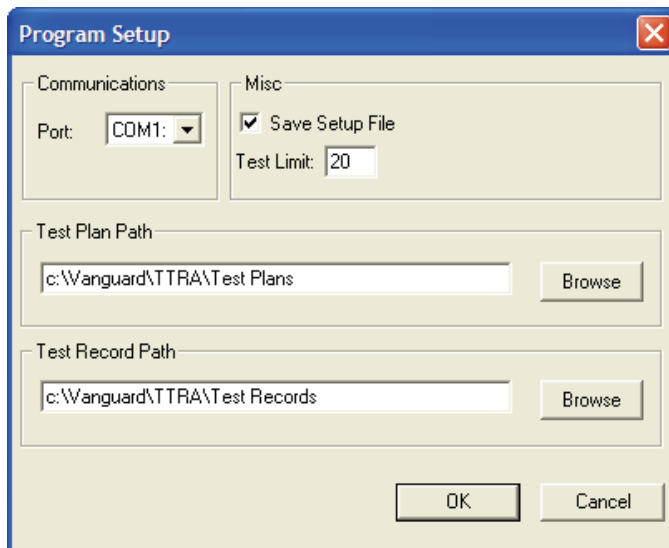
TTTRA Main Menu Structure



3.2 System Configuration

Before using the program, the system configuration parameters should be reviewed and changed as required. To configure the program settings:

1. Make sure the TTRA software is running on the PC.
2. Click on the **System-Config** menu (Alternatively you can click on the **File** menu and select *System Config...*). The following window will be displayed:



a. Communications

Select the RS-232C COM: port that the ATRT is connected to from the “Port:” drop down list.

b. Misc

Make sure the “Save Setup File” checkbox is checked if you would like to permanently save the configuration settings. If this box is not checked, any settings you change will only stay active for the current session and will be reset the next time you run the software.

Type the number of tests that need to be run in the “Test Limit” input box. The test limit defines the number of tests to be used in the transformer test plan. For example, if the transformer has 10 tap positions, the test limit should be set to 10.

c. Test Plan Path

The default location where test plans are stored on the PC hard drive is listed in the “Test Plan Path” section. You can change the default storage location by clicking on the “Browse” button and then selecting a different folder.

d. Test Record Path

The default location where test records are stored on the PC hard drive is listed in the “Test Record Path” section. You can change the default storage location by clicking on the “Browse” button and then selecting a different folder.

3. Click on the “OK” button to apply all changes to the program settings.

3.3 Enabling the ATRT's Computer Interface

To retrieve test records and test plans from an ATRT using the TTRA software, the ATRT must be in Computer Interface Mode. Also, Computer Interface Mode must be enabled when transferring test plans to an ATRT or when performing tests from the TTRA software. To enable the Computer Interface Mode:

1. Make sure the TTRA software is running on the PC and the system settings have been configured correctly (see section 3.2).
2. Connect the ATRT to the PC via the RS-232C port and turn on the power.
3. Once the ATRT has gone through the start-up cycle, the "START-UP" menu will be displayed as shown:

```
1. TEST XFMR 07/07/09
2. SETUP      07:24:05
3. CALCULATOR
4. DIAG  5. QUICK TST
```

Press the **[2]** key (*SETUP*).

4. The following screen will be displayed:

```
1. ENTER XFMR ID
2. REVIEW RECORD
3. RESTORE RECORD
4. NEXT PAGE
```

Press the **[4]** key (*NEXT PAGE*).

5. The following screen will be displayed:

```
1. COMPUTER CONTROL
2. SET TIME
3. SET TEST VOLTAGE
4. TEST PLANS
```

Press the **[1]** key (*COMPUTER CONTROL*).

6. The following screen will be displayed:

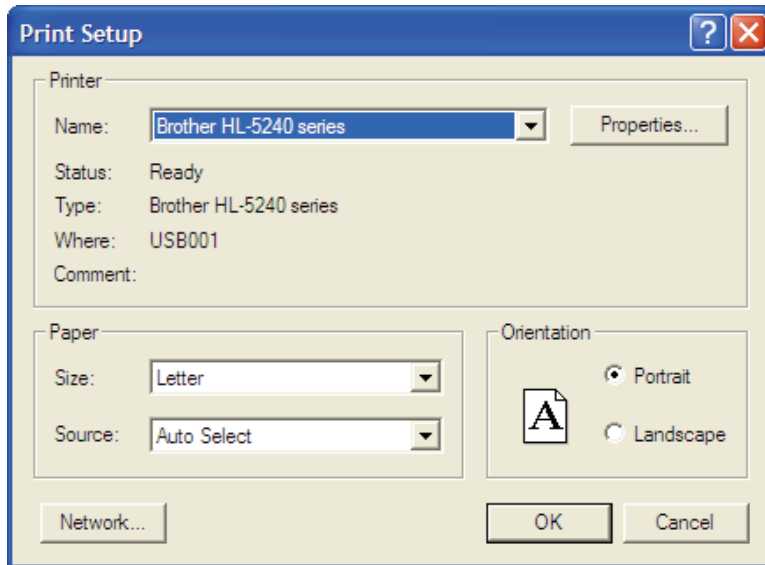
```
COMPUTER ITF MODE
*** CAUTION! ***
CABLES MAY HAVE VLTG
"STOP" TO ABORT
```

The ATRT is now in Computer Interface Mode and can be controlled by the TTRA software.

3.4 Printer Setup

To setup the printer:

1. Click on the **File** menu and select *Print Setup...* The following window will be displayed:



2. Select the printer you would like to use from the “Name” drop-down list.
3. Select the appropriate options for the printer.
4. Click on the “OK” button.

4.0 WORKING WITH TEST RECORDS

The TTRA software can be used to retrieve test records from the ATRT or from the PC hard drive. Once a test record is retrieved, you can change the record header settings, print the test results, change the H Voltage, X Voltage, H Tap, and X Tap values, and save the record to the hard drive.



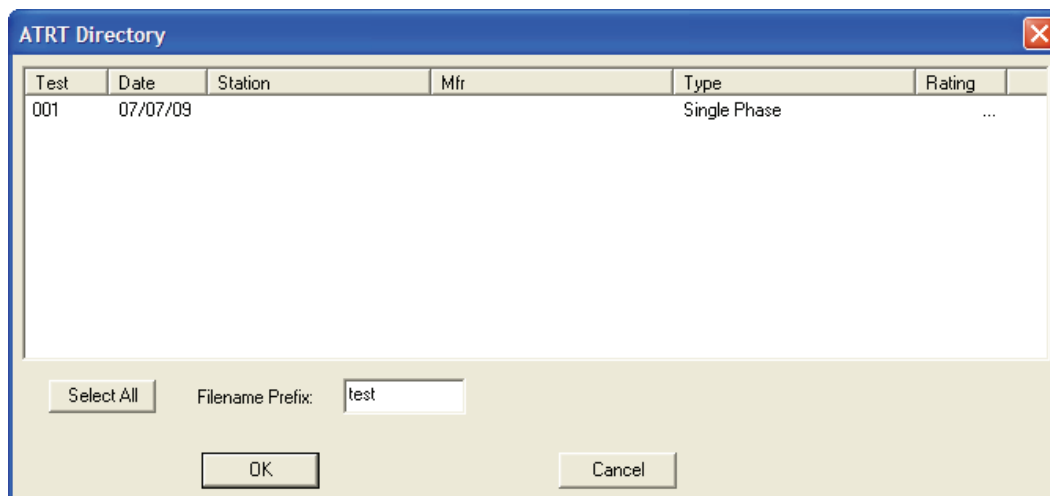
NOTE

If the H Voltage and/or X Voltage values are changed, the TTRA software will automatically re-calculate the calculated ratio and deviation. Make sure to save the test record after making any changes. See section 4.3 for information on saving test records.

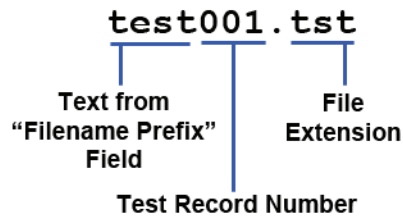
4.1 Retrieving Test Records From an ATRT

To retrieve a test record from an ATRT:

1. Make sure the TTRA software is running. Connect the ATRT to the PC via the RS-232C port and put it in Computer Interface Mode (see section 3.3).
2. From the **Retrieve** or **File** menu select *Retrieve Test Record From ATRT*.
3. A window will appear listing a directory of all the test records stored in the ATRT's memory as shown:



4. You can select a test record to be retrieved by clicking on the test record number. The selected record will be highlighted. You may select multiple records by holding down the **[CTRL]** key and clicking on the record numbers. All selected records will be highlighted. You may de-select a selected record by holding down the **[CTRL]** key and clicking on the selected record number a second time. To select all of the test records, click on the "Select All" button.
5. The "Filename Prefix" input field allows you to enter a word that will be used as part of the filename for the stored record on the PC hard drive. When a test record is retrieved from an ATRT and stored on the hard drive, the filename is in the following format:

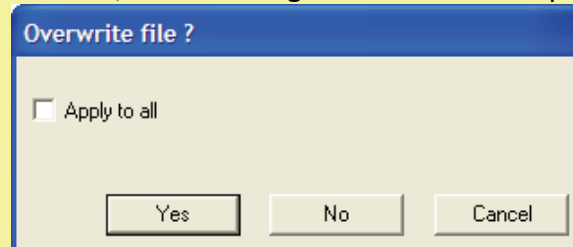


So if you would like the filename to be "*sample_test001.tst*", enter the word *sample_test* in the "Filename Prefix" input field.

6. Click on the "OK" button. The test record will be retrieved from the ATRT and saved on the PC in the default test records directory (see section 3.2 for information on how to change the default test records directory).



If a test record file with the same name already exists at the storage location, the following window will be displayed:

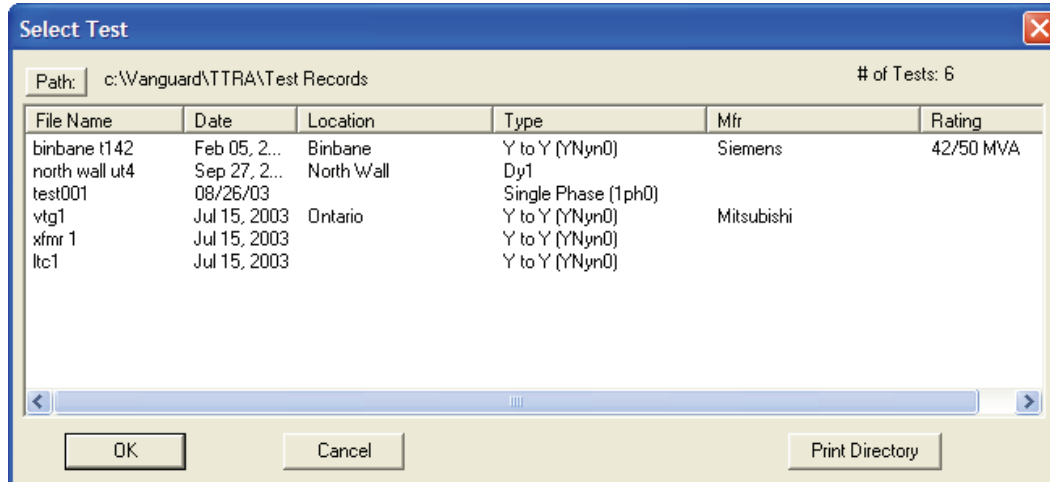


To overwrite the existing file, click on the "Yes" button. If you do not want to overwrite the existing file with the retrieved test record, click on the "No" button and you will be able to enter a different filename for the retrieved test record.

4.2 Recalling a Test Record From the PC Hard Drive

Test records stored on the PC hard drive can be recalled using the steps below:

1. Click on the **Recall Test** menu (or click on the **File** menu and select *Recall Test...*). The following window will be displayed:



- The top left section of the window displays the name of the directory where the test records are being retrieved from. If you wish to retrieve records from a different directory, click on the “Path:” button and browse to the folder containing the test records.
 - The top right section of the window displays the total number of test records stored in the current directory.
 - If you would like to print the current directory listing, click on the “Print Directory” button at the bottom of the window. Select the printer to print to and click on the “OK” button.
2. Click on the filename you would like to retrieve and click the “OK” button. The test record will be loaded and the tabulated test results will be displayed (please see section 4.8 for details).

4.3 Saving a Test Record

4.3.1. Saving a Test Record With Its Original Filename

1. If changes have been made to the current test record and you would like to save it with its original filename, click on the **Save** menu and select *Overwrite*.



Alternatively, you can select the *Save* option from the **File** menu.

NOTE

2. The test record will be saved with its original filename.

4.3.2. Saving a Test Record With a Different Filename

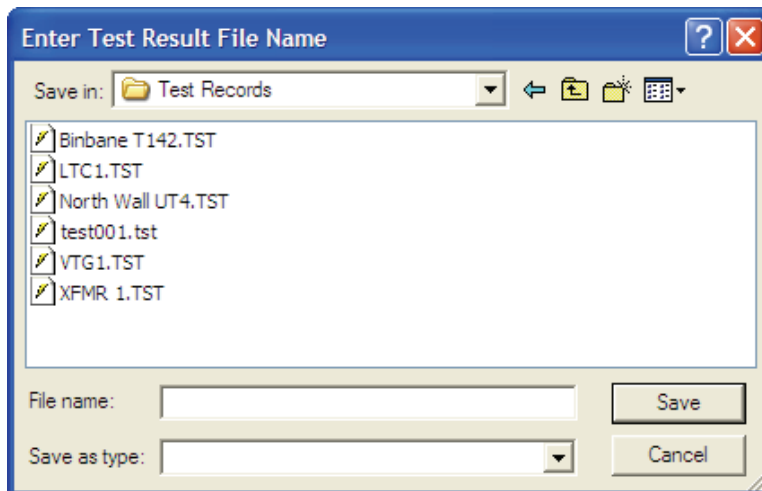
1. To save an open test record with a different filename, click on the **Save** menu and select *Save As...*



Alternatively, you can select the *Save As...* option from the **File** menu.

NOTE

The following window will be displayed:

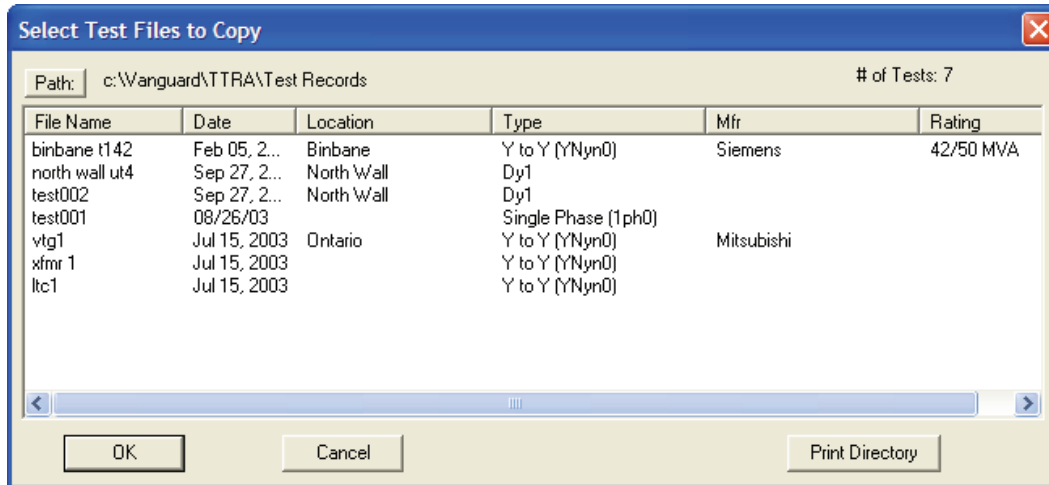


2. Browse to the folder where you would like to save the test record.
3. Enter the filename in the “Filename:” input field.
4. Click on the “Save” button. The test record will be saved with the new filename.

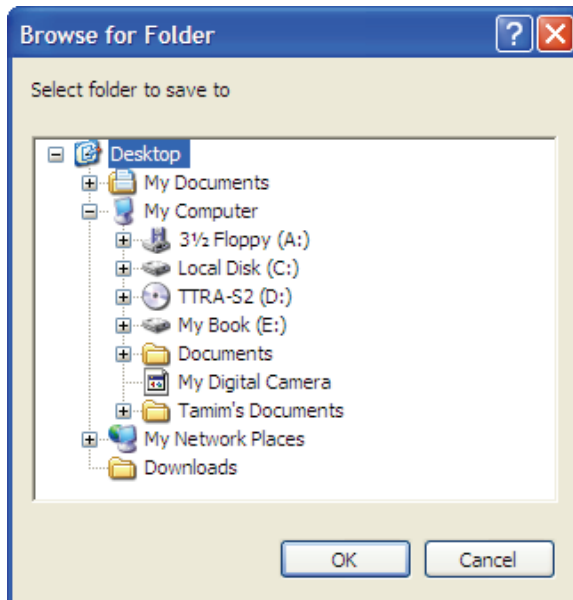
4.4 Copying Test Records

To copy a test record from one location on the PC hard drive to another location:

1. From the **File-Util** menu, click on *Copy* and then select *Test* (alternatively you can click on the **File** menu, click on *File Utilities*, click on *Copy* and then select *Test*). The following window will be displayed:



2. If the test record you would like to copy is not in the current directory, click on the "Path:" button at the top of the window and browse to the directory containing the file. Once you have located the test record to be copied, click on the filename. You may select additional test records by holding down the **[CTRL]** key and clicking on each subsequent filename. Once you have selected the test record(s) to be copied, click on the "OK" button. The following window will be displayed:

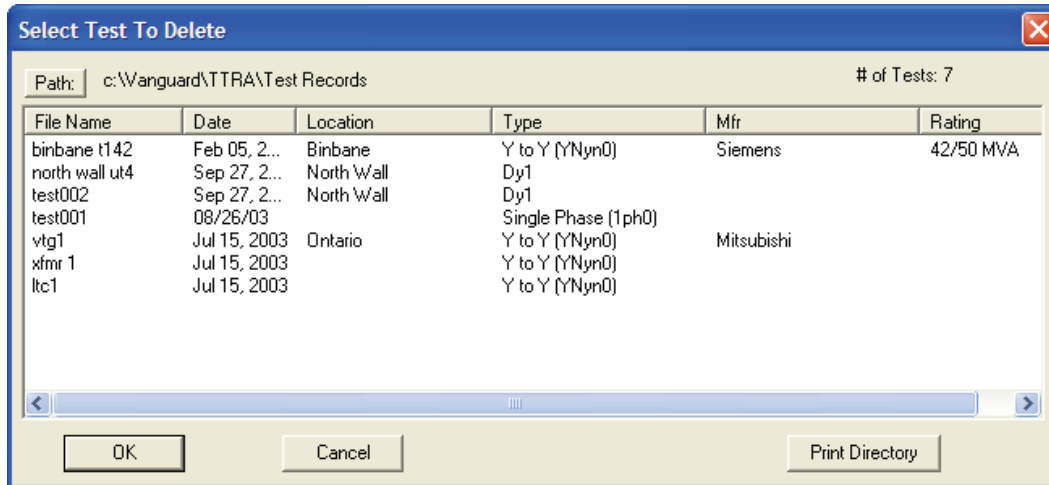


3. Browse to the folder where you would like the test record to be copied to, and then click on the "OK" button. The test record will be copied to this folder with the same filename as the original.

4.5 Deleting Test Records

To delete a test record stored on the PC hard drive:

1. From the **File-Util** menu, click on *Delete* and then select *Test...* (alternatively you can click on the **File** menu, click on *File Utilities*, click on *Delete*, and then select *Test...*). The following window will be displayed:

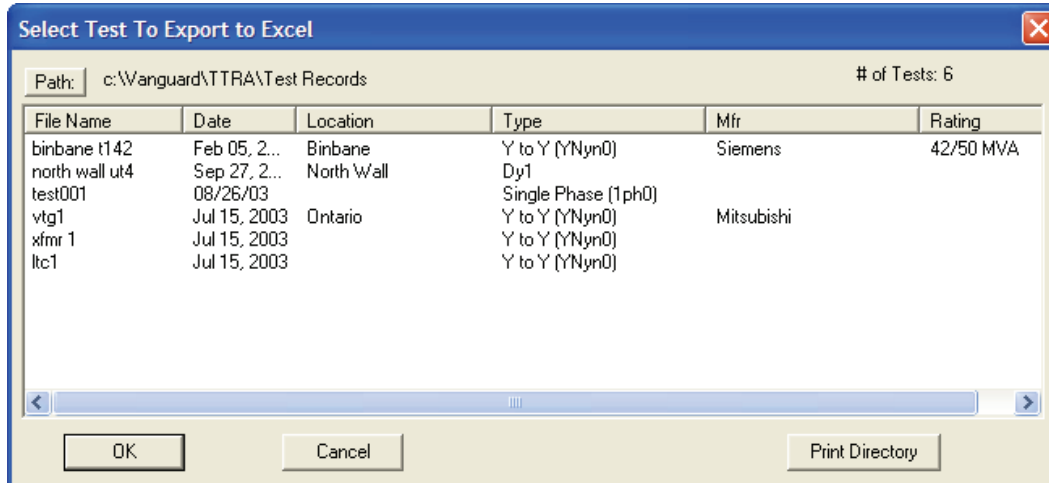


2. If the test record you would like to delete is not in the current directory, click on the "Path:" button at the top of the window and browse to the directory containing the file. Once you have located the test record to be deleted, click on the filename. You may select additional test records by holding down the **[CTRL]** key and clicking on each subsequent filename. Once you have selected the test record(s) to be deleted, click on the "OK" button. The selected test record(s) will be permanently deleted from the PC hard drive.

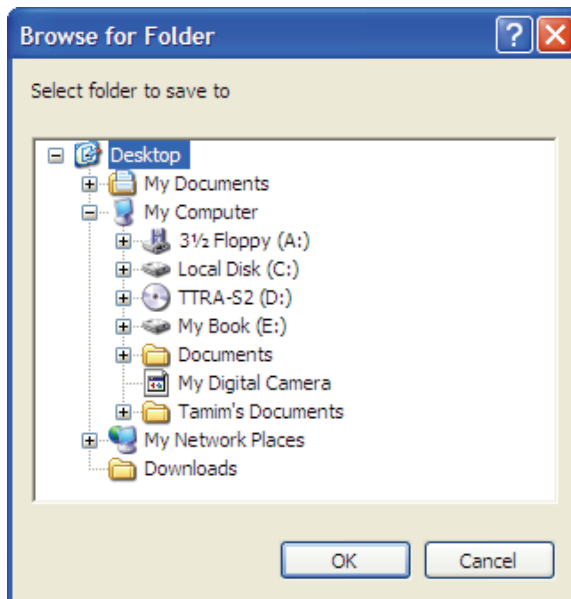
4.6 Exporting a Test Record in Microsoft® Excel® Format

You can export a test record in Microsoft® Excel® format. To export a test record in Excel® format:

1. From the **File-Util** menu, click on *Export* and then select *Test Record to Excel* (alternatively you can click on the **File** menu, click on *File Utilities*, click on *Export*, and then select *Test Record to Excel*). The following window will be displayed:



2. If the test record you would like to export is not in the current directory, click on the "Path:" button at the top of the window and browse to the directory containing the file. Once you have located the test record to be exported, click on the filename. You may select additional test records by holding down the **[CTRL]** key and clicking on each subsequent filename. Once you have selected the test record(s) to be exported, click on the "OK" button. The following window will be displayed:



- Browse to the folder where you would like the Excel® file(s) to be saved and click on the “OK” button. Figure 1 shows a test record in the TTRA software compared with the exported data in Excel®.

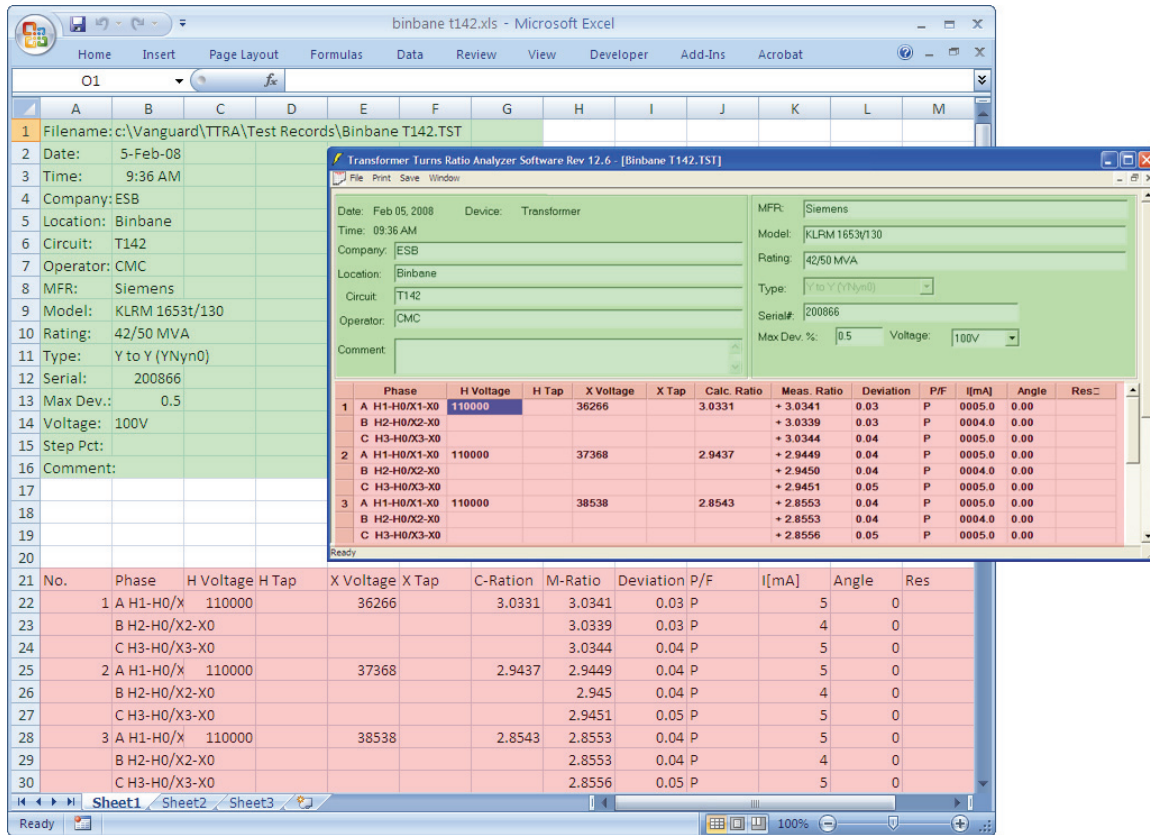
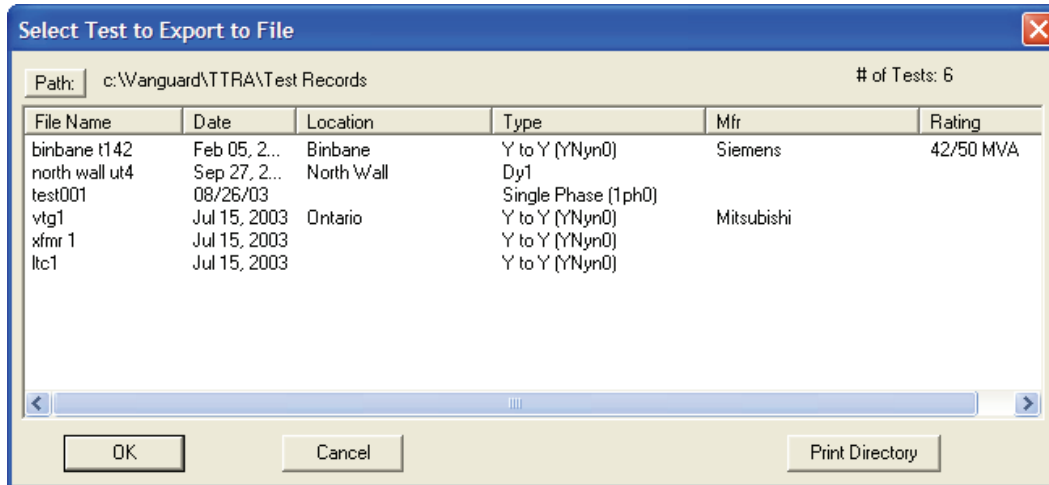


Figure 1. Test Record in TTRA Software and Microsoft Excel

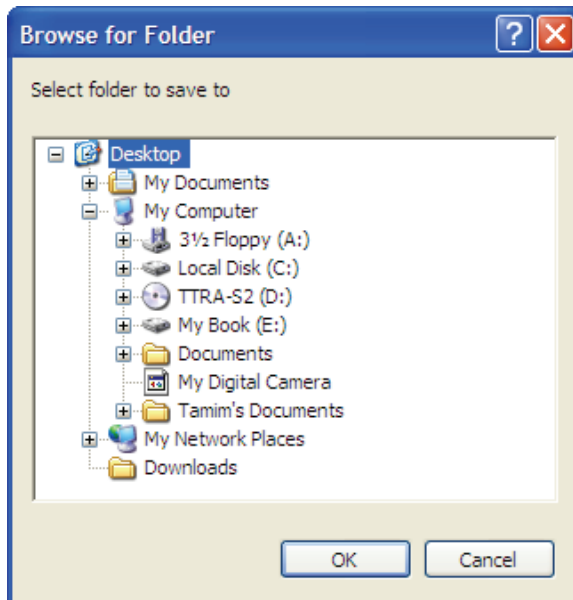
4.7 Exporting a Test Record to a Text File

You can also export a test record to a text file. To export a test record to a text file:

1. From the **File-Util** menu, click on *Export* and then select *Test Record to Text File* (alternatively you can click on the **File** menu, click on *File Utilities*, click on *Export*, and then select *Test Record to Text File*). The following window will be displayed:



2. If the test record you would like to export is not in the current directory, click on the "Path:" button at the top of the window and browse to the directory containing the file. Once you have located the test record to be exported, click on the filename. You may select additional test records by holding down the **[CTRL]** key and clicking on each subsequent filename. Once you have selected the test record(s) to be exported, click on the "OK" button. The following window will be displayed:



3. Browse to the folder where you would like the text file(s) to be saved and click on the "OK" button.

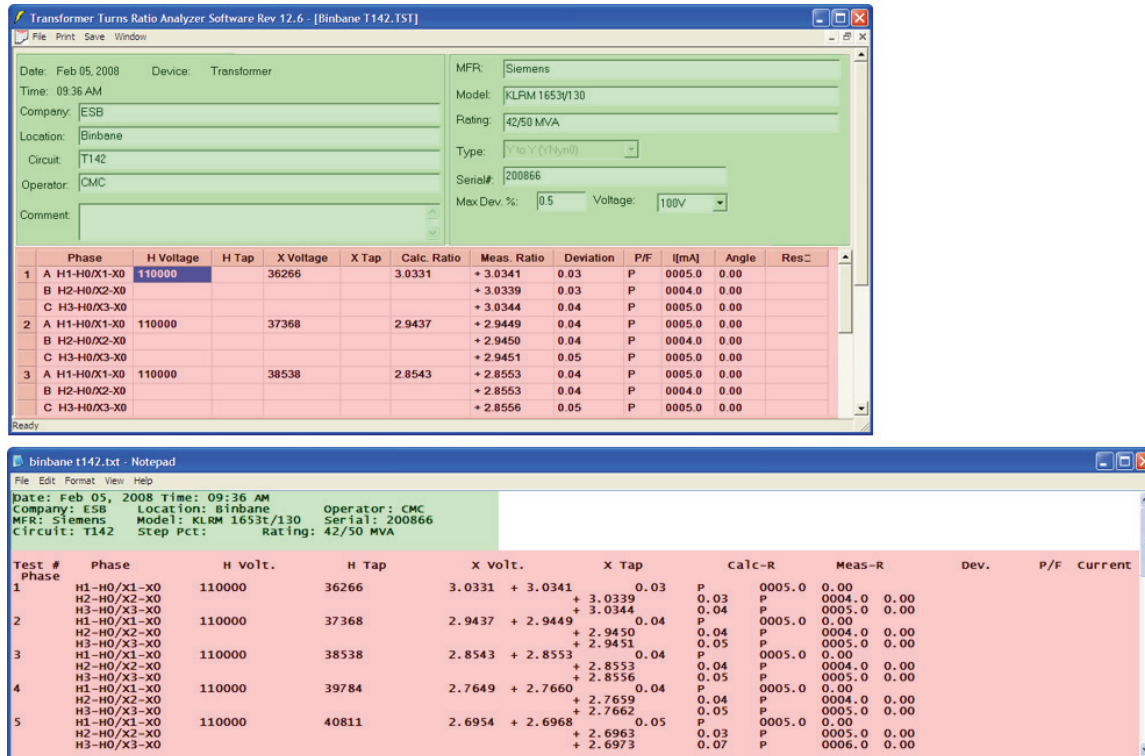


Figure 2. Test Record in TTRA Software and in Text Format

4.8 Working with Tabulated Test Results

Once a test record has been retrieved (see sections 4.1 and 4.2 for instructions), the record details will be displayed as shown:

Transformer Turns Ratio Analyzer Software Rev 12.6 - [Binbane T142.TST]

File Print Save Window

Date: Feb 05, 2008 Device: Transformer
Time: 09:36 AM
Company: ESB
Location: Binbane
Circuit: T142
Operator: CMC
Comment:

MFR: Siemens
Model: KLRM 1653/130
Rating: 42/50 MVA
Type: Y to Y (YNyn0)
Serial#: 200866
Max Dev. %: 0.5 Voltage: 100V

	Phase	H Voltage	H Tap	X Voltage	X Tap	Calc. Ratio	Meas. Ratio	Deviation	P/F	I[mA]	Angle	Res
1	A H1-H0/X1-X0	110000		36266		3.0331	+ 3.0341	0.03	P	0005.0	0.00	
	B H2-H0/X2-X0						+ 3.0339	0.03	P	0004.0	0.00	
	C H3-H0/X3-X0						+ 3.0344	0.04	P	0005.0	0.00	
2	A H1-H0/X1-X0	110000		37368		2.9437	+ 2.9449	0.04	P	0005.0	0.00	
	B H2-H0/X2-X0						+ 2.9450	0.04	P	0004.0	0.00	
	C H3-H0/X3-X0						+ 2.9451	0.05	P	0005.0	0.00	
3	A H1-H0/X1-X0	110000		38538		2.8543	+ 2.8553	0.04	P	0005.0	0.00	
	B H2-H0/X2-X0						+ 2.8553	0.04	P	0004.0	0.00	
	C H3-H0/X3-X0						+ 2.8556	0.05	P	0005.0	0.00	
4	A H1-H0/X1-X0	110000		39784		2.7649	+ 2.7660	0.04	P	0005.0	0.00	
	B H2-H0/X2-X0						+ 2.7659	0.04	P	0004.0	0.00	
	C H3-H0/X3-X0						+ 2.7662	0.05	P	0005.0	0.00	
5	A H1-H0/X1-X0	110000		40811		2.6954	+ 2.6968	0.05	P	0005.0	0.00	
	B H2-H0/X2-X0						+ 2.6963	0.03	P	0005.0	0.00	
	C H3-H0/X3-X0						+ 2.6973	0.07	P	0006.0	0.00	
6	A H1-H0/X1-X0	110000		41892		2.6258	+ 2.6274	0.06	P	0006.0	0.00	
	B H2-H0/X2-X0						+ 2.6273	0.06	P	0005.0	0.00	
	C H3-H0/X3-X0						+ 2.6275	0.06	P	0006.0	0.00	

Run Test Next Test Repeat Test Notepad

Ready

The menus on the menu bar will also change to provide additional options relevant to working with a test record.

You can edit the test record header information (such as Company, Location, Circuit, Operator, etc.) by entering data in the corresponding fields at the top of the screen.

You can also edit the H Voltage, H Tap, X Voltage, and X Tap values. If these values are changed, the calculated ratio and deviation will be automatically re-calculated by the TTRA software. Make sure to save the test record after making any changes.

The Max Dev. % value can be edited as well. If this value is changed, any tests that fail based on the new value will be highlighted as shown below:

Transformer Turns Ratio Analyzer Software Rev 12.6 - [Binbane T142.TST]

File Print Save Window

Date: Feb 05, 2008 Device: Transformer
Time: 09:36 AM
Company: ESB
Location: Binbane
Circuit: T142
Operator: CMC
Comment:

MFR: Siemens
Model: KLRM 1653/130
Rating: 42/50 MVA
Type: Y to Y (YNyn0)
Serial#: 200866
Max Dev. %: 0.04 Voltage: 100V

	Phase	H Voltage	H Tap	X Voltage	X Tap	Calc. Ratio	Meas. Ratio	Deviation	P/F	I[mA]	Angle	Res
1	A H1-H0/X1-X0	110000		36266		3.0331	+ 3.0341	0.03	P	0005.0	0.00	
	B H2-H0/X2-X0						+ 3.0339	0.03	P	0004.0	0.00	
	C H3-H0/X3-X0						+ 3.0344	0.04	F	0005.0	0.00	
2	A H1-H0/X1-X0	110000		37368		2.9437	+ 2.9449	0.04	F	0005.0	0.00	

4.8.1. Printing the Tabulated Test Results

To print the tabulated test results:

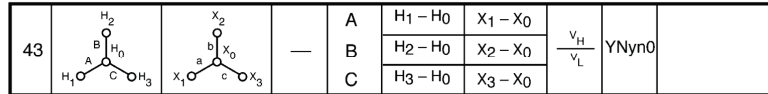
1. Click on the ***Print*** menu. The print dialog box will appear.
2. Select the printer to print to and make any necessary changes to the printer's parameters and then click on the "OK" button. The test results will be printed. A sample test record printout is shown in Figure 3.

TRANSFORMER TURNS RATIO REPORT

Filename: Binbane T142.TST Date: Feb 05, 2008 Time: 09:36 AM Page (1/3)

Company: ESB
 Location: Binbane
 Circuit: T142
 Operator: CMC
 Comment:

MFR: Siemens
 Device: Transformer
 Type: Y to Y (YNyn0)
 Model: KLRM 1653t/130
 Rating: 42/50 MVA
 Serial #: 200866
 Max Deviation %: 0.5
 Test Voltage: 100V



TEST	H VOLT	H TAP	X VOLT	X TAP	C-RATIO	M-RATIO	DEV [%]	P/F	I[mA]	DEGREE	RES
1	110000		36266		3.0331	A: + 3.0341 B: + 3.0339 C: + 3.0344	0.03 0.03 0.04	P P P	5.0 4.0 5.0	0.00 0.00 0.00	
2	110000		37368		2.9437	A: + 2.9449 B: + 2.9450 C: + 2.9451	0.04 0.04 0.05	P P P	5.0 4.0 5.0	0.00 0.00 0.00	
3	110000		38538		2.8543	A: + 2.8553 B: + 2.8553 C: + 2.8556	0.04 0.04 0.05	P P P	5.0 4.0 5.0	0.00 0.00 0.00	
4	110000		39784		2.7649	A: + 2.7660 B: + 2.7659 C: + 2.7662	0.04 0.04 0.05	P P P	5.0 4.0 5.0	0.00 0.00 0.00	
5	110000		40811		2.6954	A: + 2.6968 B: + 2.6963 C: + 2.6973	0.05 0.03 0.07	P P P	5.0 5.0 6.0	0.00 0.00 0.00	
6	110000		41892		2.6258	A: + 2.6274 B: + 2.6273 C: + 2.6275	0.06 0.06 0.06	P P P	6.0 5.0 6.0	0.00 0.00 0.00	
7	110000		43031		2.5563	A: + 2.5580 B: + 2.5577 C: + 2.5580	0.07 0.05 0.07	P P P	6.0 5.0 6.0	0.00 0.00 0.00	
8	110000		44234		2.4868	A: + 2.4884 B: + 2.4881 C: + 2.4890	0.06 0.05 0.09	P P P	6.0 5.0 6.0	0.00 0.00 0.00	
9	110000		45321		2.4271	A: + 2.4291 B: + 2.4285 C: + 2.4293	0.08 0.06 0.09	P P P	6.0 5.0 6.0	0.00 0.00 0.00	
10	110000		46462		2.3675	A: + 2.3694 B: + 2.3690 C: + 2.3699	0.08 0.06 0.10	P P P	6.0 5.0 7.0	0.00 0.00 0.16	

Transformer Turns Ratio Analyzer Software Rev 12.6
 Vanguard Instruments Co. Inc.
 www.vanguard-instruments.com

Figure 3. A Typical Test Record Printout

4.8.2. Displaying the Deviation Graph

The deviation graph is a useful tool for analyzing the transformer ratio deviation. The deviation graph displays the phase A, B, and C turns-ratio deviation of the current test record. The following formula is used to calculate the deviation, or percent difference:

$$\text{Deviation} = |[(\text{Ratio}_{\text{calculated}} - \text{Ratio}_{\text{measured}}) / \text{Ratio}_{\text{calculated}}] \times 100|$$

To display the deviation graph for the loaded test record, click on the **File** menu and then select the *Display Deviation Graph* option. A typical deviation graph is shown below in Figure 4.

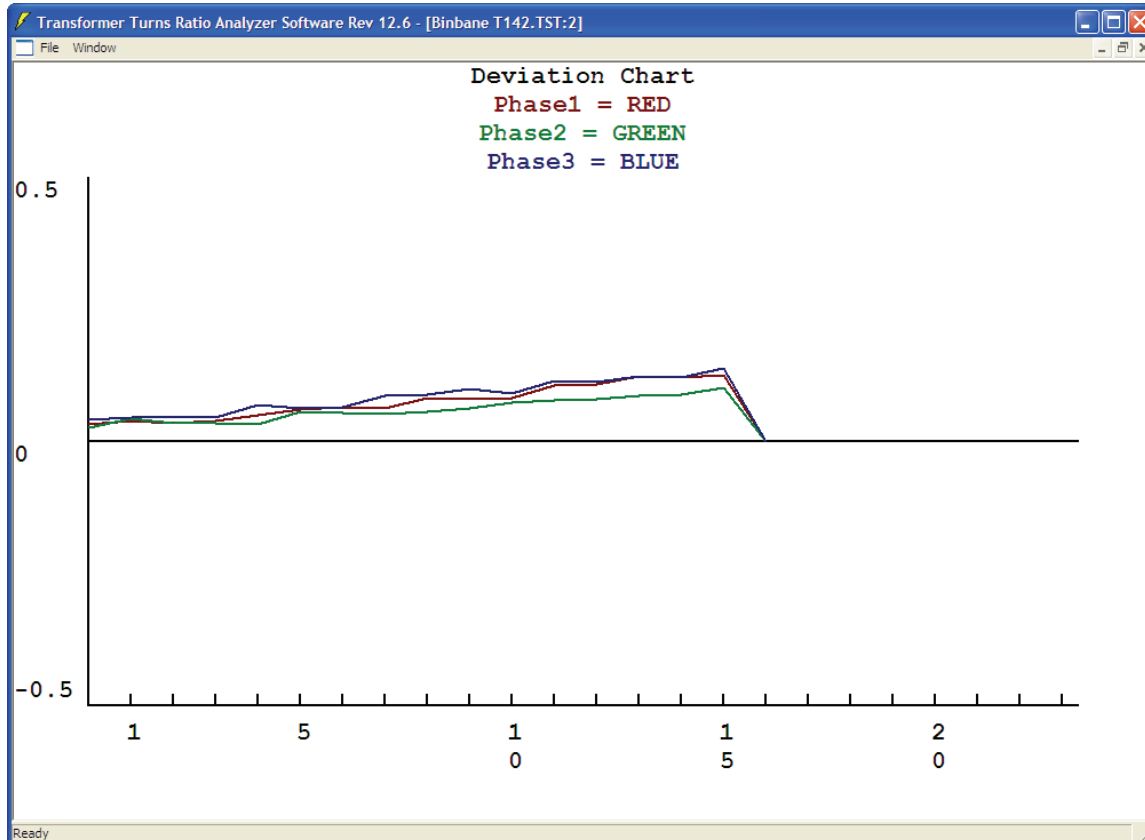


Figure 4. A Typical Deviation Graph

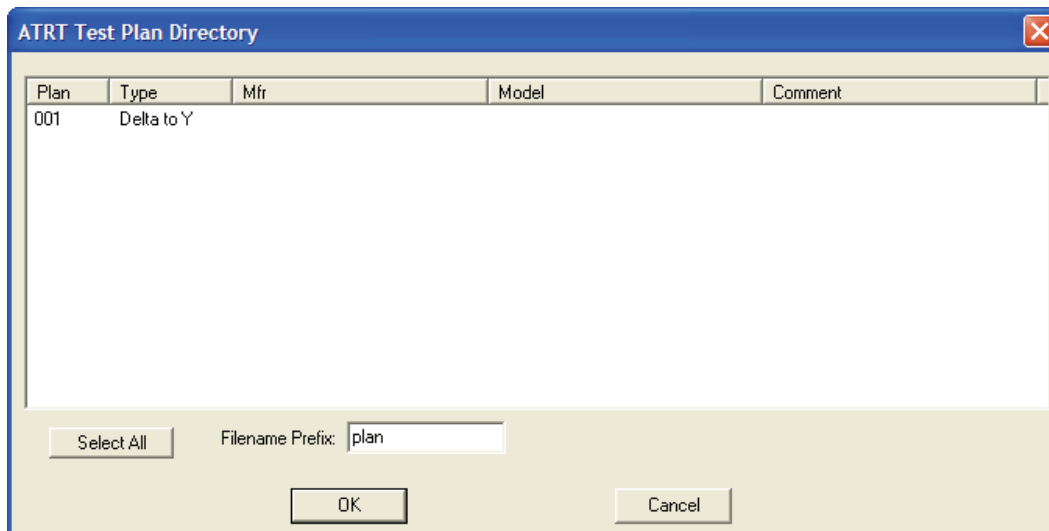
5.0 WORKING WITH TEST PLANS

The TTRA software can be used to create transformer, load tap changer, and voltage regulator test plans on the PC. Test plans can then be run from the PC or transferred to the ATRT to be run from the ATRT (in stand-alone mode). Test plans can also be retrieved from the ATRT using the TTRA software.

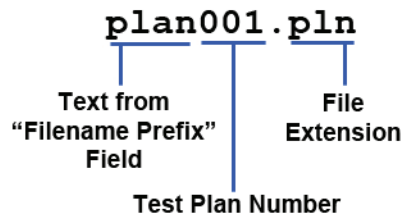
5.1 Retrieving Test Plans From an ATRT

To retrieve a test plan from an ATRT:

1. Make sure the TTRA software is running. Connect the ATRT to the PC via the RS-232C port and put it in Computer Interface Mode (please see section 3.3).
2. From the **Test-Plan** menu select *Retrieve Test Plan From ATRT* (alternatively you can select *Retrieve Test Plan From ATRT* from the **File** menu).
3. A window will appear listing a directory of all the test plans stored in the ATRT's memory as shown:



4. You can select a test plan to be retrieved by clicking on the test plan number. The selected test plan will be highlighted. You may select multiple test plans by holding down the **[CTRL]** key and clicking on the test plan numbers. All selected test plans will be highlighted. You may de-select a selected test plan by holding down the **[CTRL]** key and clicking on the selected test plan number a second time. To select all of the test plans, click on the "Select All" button.
5. The "Filename Prefix" input field allows you to enter a word that will be used as part of the filename for the stored test plan on the PC hard drive. When a test plan is retrieved from a ATRT and stored on the hard drive, the filename is in the following format:



So if you would like the filename to be *"sample_plan001.pln"*, enter the word *sample_plan* in the "Filename Prefix" input field.

6. Click on the "OK" button. The test plan will be retrieved from the ATRT and stored on the PC in the default test plans directory (see section 3.2 for information on how to change the default test plan directory).



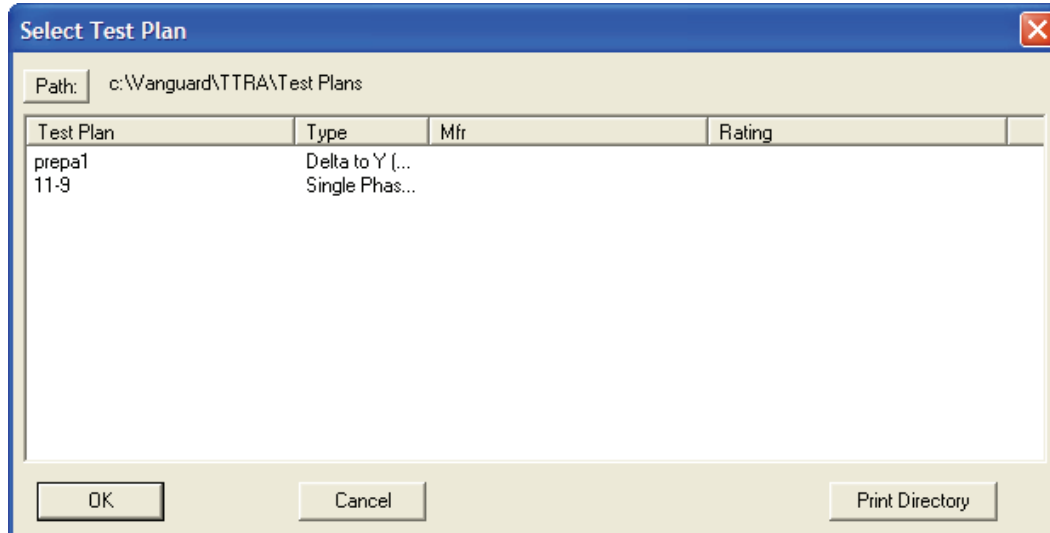
If a test plan file with the same name already exists at the storage location, the file will be over-written with the newly transferred file.

NOTE

5.2 Recalling a Test Plan From the PC Hard Drive

Test plans stored on the PC hard drive can be recalled using the steps below:

1. From the **File** menu or the **Test-Plan** menu, click on *Recall Test Plan...* The following window will be displayed:

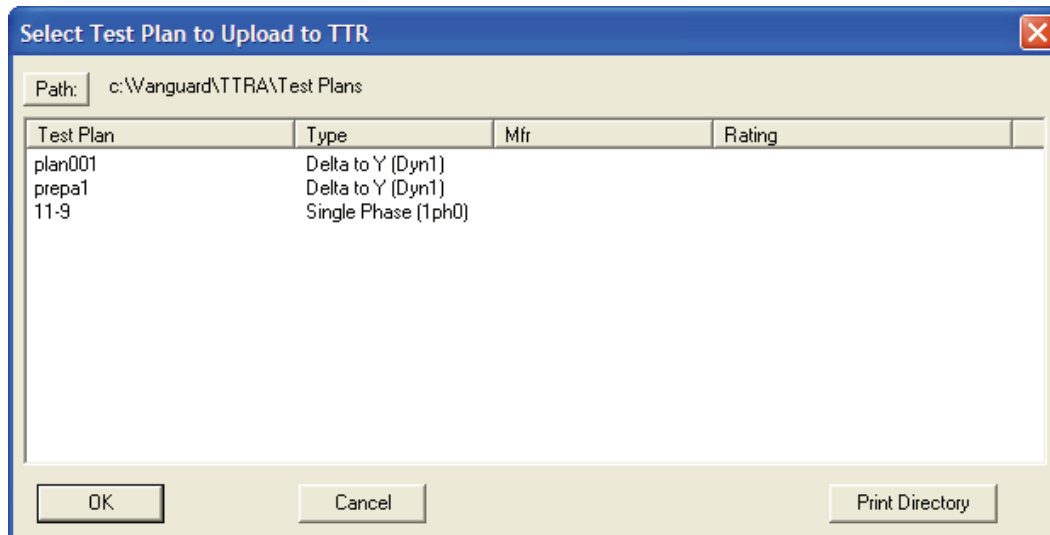


- The top left section of the window displays the name of the directory where the test plans are being retrieved from. If you wish to retrieve test plans from a different directory, click on the “Path:” button and browse to the folder containing the test plans.
 - If you would like to print the current directory listing, click on the “Print Directory” button at the bottom of the window. Select the printer to print to and click on the “OK” button.
2. Click on the filename you would like to retrieve and click the “OK” button. The test plan will be loaded and the test plan parameters will be displayed. You may change any of the test plan parameters as needed.

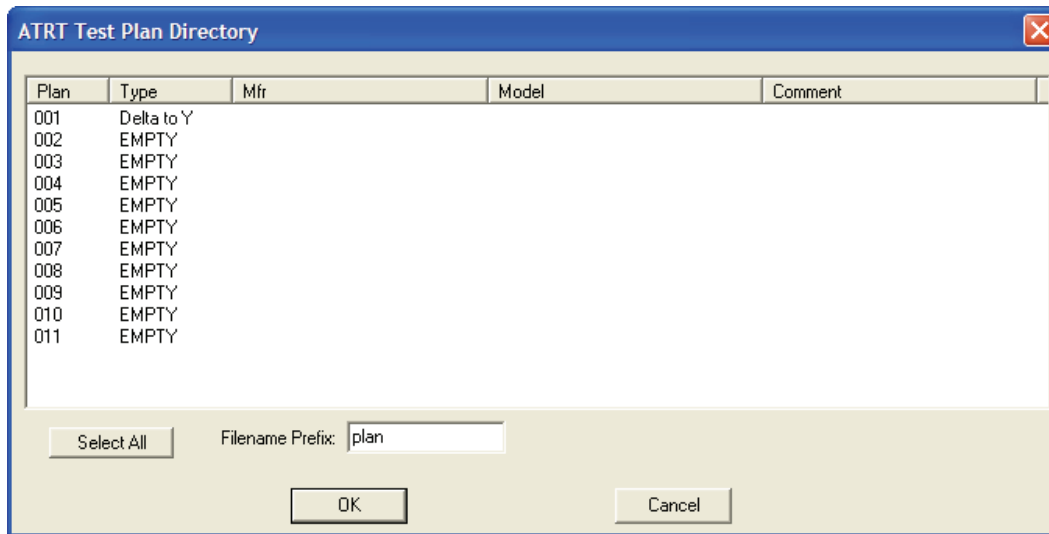
5.3 Transferring Test Plans to an ATRT

To transfer a test plan from the PC hard drive to an ATRT:

1. From the **File** menu or the **Test-Plan** menu, click on *Upload Test Plan to ATRT*. The following window will be displayed:



- The top left section of the window displays the name of the directory where the test plans are being listed from. If you wish to transfer test plans from a different directory, click on the “Path:” button and browse to the folder containing the test plans.
 - If you would like to print the current directory listing, click on the “Print Directory” button at the bottom of the window. Select the printer to print to and click on the “OK” button.
2. Click on the filename you would like to transfer to the ATRT and click on the “OK” button. The following window will be displayed showing a listing of the ATRT’s test plan memory locations and their contents:



- Click on an empty location where you would like the test plan to be transferred to and click on the “OK” button. The test plan will be transferred to the selected location in the ATRT’s memory.

**NOTE**

If there are no empty memory locations available, you can select a memory location with data in it, and it will be over-ridden with the transferred test plan.

5.4 Saving a Test Plan

5.4.1. Saving a Test Plan With Its Original Filename

1. If changes have been made to the current test plan and you would like to save it with its original filename, click on the **Save** menu and select *Overwrite*.



Alternatively, you can select the *Save* option from the **File** menu.

NOTE

2. The test plan will be saved with its original filename.

5.4.2. Saving a Test Plan With a Different Filename

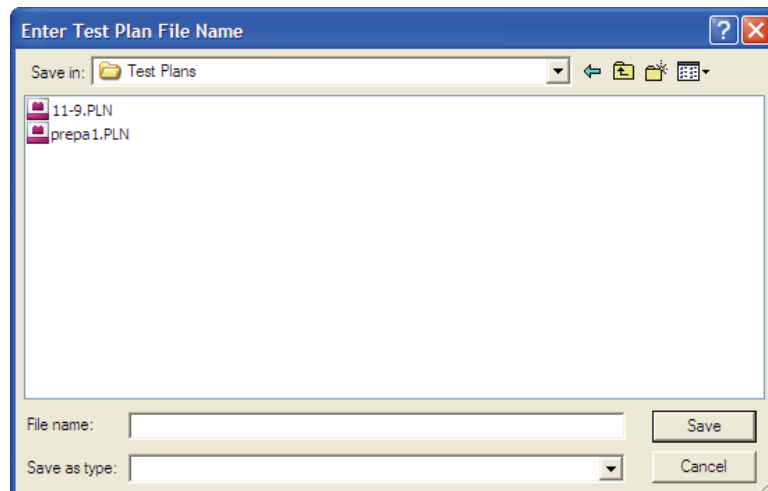
1. To save the current test plan with a different filename, click on the **Save** menu and select *Save As...*



Alternatively, you can select the *Save As...* option from the **File** menu.

NOTE

The following window will be displayed:

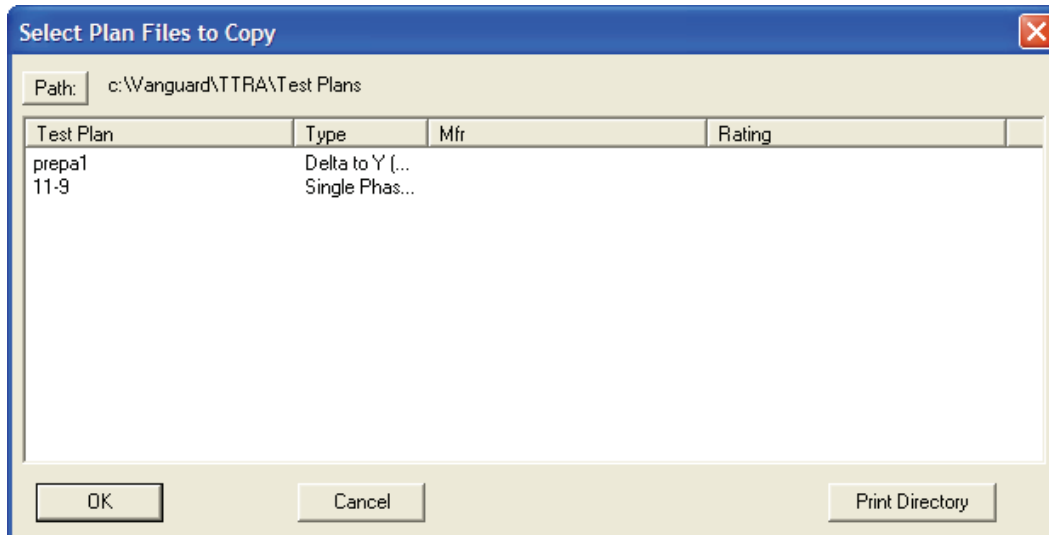


2. Browse to the folder where you would like to save the test plan.
3. Enter the filename in the “Filename:” input field.
4. Click on the “Save” button. The test plan will be saved with the new filename.

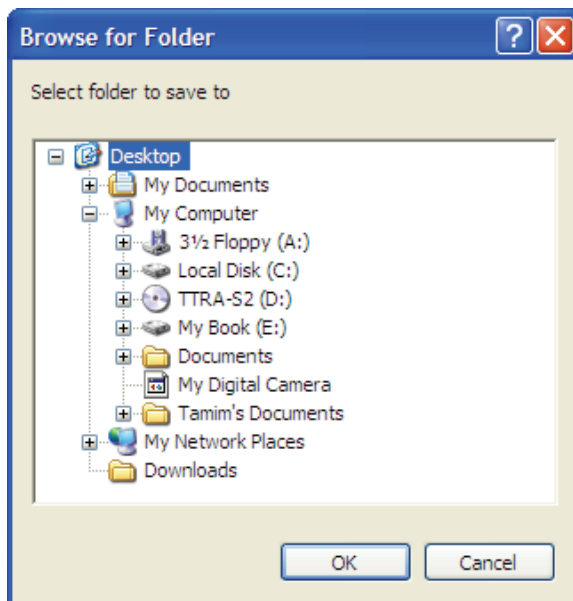
5.5 Copying Test Plans

To copy a test plan from one location on the PC hard drive to another location:

1. From the **File-Util** menu, click on *Copy* and then select *Test Plan...* (alternatively you can click on the **File** menu, click on *File Utilities*, click on *Copy* and then select *Test Plan...*)
The following window will be displayed:



2. If the test plan you would like to copy is not in the current directory, click on the "Path:" button at the top of the window and browse to the directory containing the file. Once you have located the test plan to be copied, click on the filename. You may select additional test plans by holding down the **[CTRL]** key and clicking on each subsequent filename. Once you have selected the test plan(s) to be copied, click on the "OK" button.
The following window will be displayed:

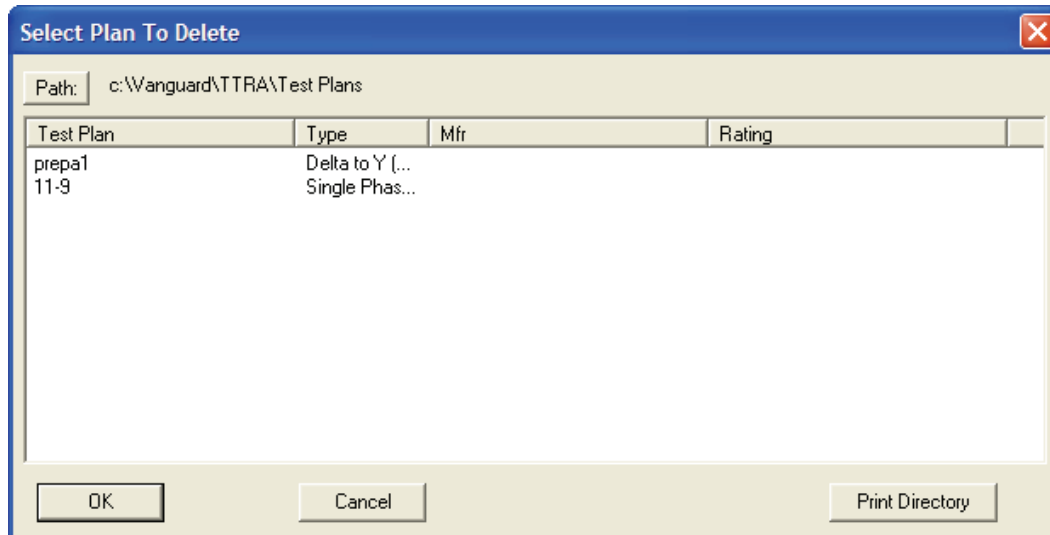


3. Browse to the folder where you would like the test plan to be copied to, and then click on the “OK” button. The test plan will be copied to this folder with the same filename as the original.

5.6 Deleting Test Plans

To delete a test plan stored on the PC hard drive:

1. From the **File-Util** menu, click on *Delete* and then select *Test Plan...* (alternatively you can click on the **File** menu, click on *File Utilities*, click on *Delete*, and then select *Test Plan...*). The following window will be displayed:

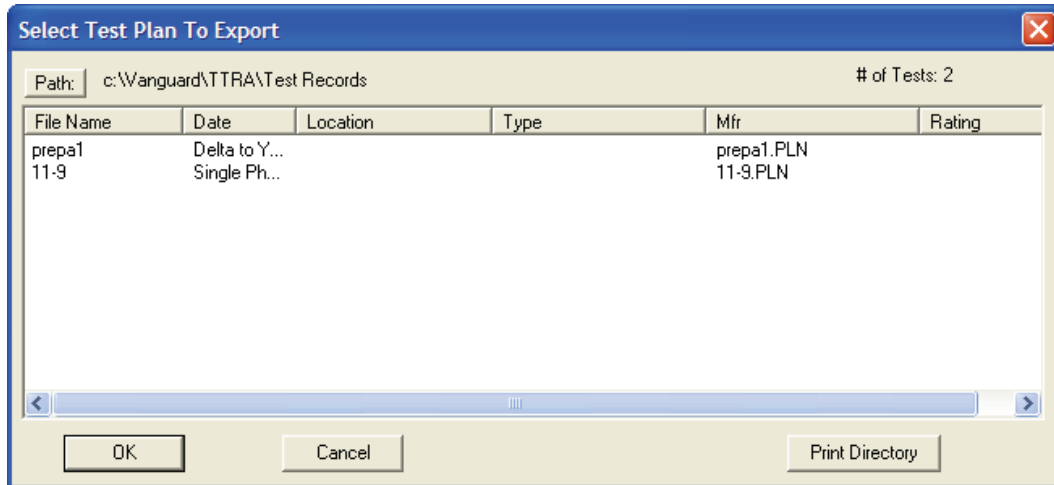


2. If the test plan you would like to delete is not in the current directory, click on the "Path:" button at the top of the window and browse to the directory containing the file. Once you have located the test plan to be deleted, click on the filename. You may select additional test plans by holding down the **[CTRL]** key and clicking on each subsequent filename. Once you have selected the test plan(s) to be deleted, click on the "OK" button. The selected test plan(s) will be permanently deleted from the PC hard drive.

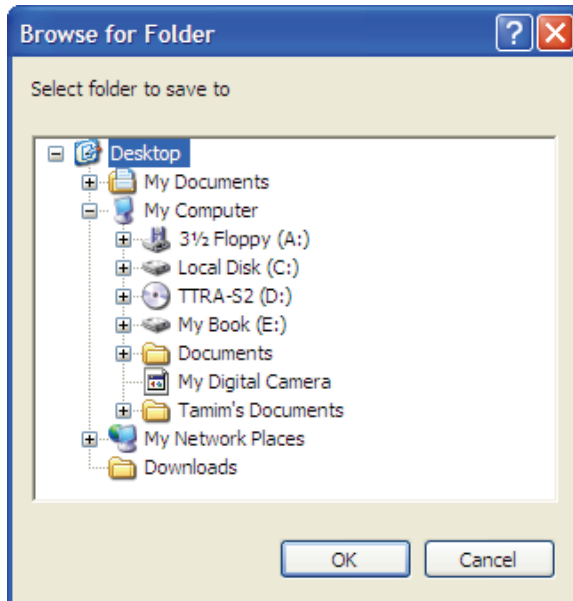
5.7 Exporting a Test Plan to a Text File

You can export a test plan to a text file by using the steps below:

1. From the **File-Util** menu, click on *Export* and then select *Test Plan to Text File* (alternatively you can click on the **File** menu, click on *File Utilities*, click on *Export*, and then select *Test Plan to Text File*). The following window will be displayed:



2. If the test plan you would like to export is not in the current directory, click on the "Path:" button at the top of the window and browse to the directory containing the file. Once you have located the test plan to be exported, click on the filename. You may select additional test plans by holding down the **[CTRL]** key and clicking on each subsequent filename. Once you have selected the test plan(s) to be exported, click on the "OK" button. The following window will be displayed:



3. Browse to the folder where you would like the text file(s) to be saved and click on the "OK" button.

5.8 Creating Test Plans

The TTRA software can be used to create test plans for transformers, load tap changers, and voltage regulators.

5.8.1. Creating a Test Plan for a Transformer

To create a test plan for a transformer:

1. From the **Test-Plan** menu or the **File** menu, click on *Create Test Plan*, and then click on *Transformer*. An empty test plan will be displayed as shown below:

The screenshot shows the 'Transformer Turns Ratio Analyzer Software Rev 12.6 - [Untitled Test Plan #1]' window. The top section contains input fields for Date (Jul 06, 2009), Time (10:31 AM), Device (Transformer), Company, Location, Circuit, Operator, and Comment. The right section contains input fields for MFR, Model, Rating, Type (Single Phase (1ph0)), Serial#, Max Dev. % (0.5), and Voltage (40V). Below these is a table with columns: Phase, H Voltage, H Tap, X Voltage, X Tap, Calc. Ratio, Meas. Ratio, Deviation, P/F, I[mA], Angle, and Res. The table has 18 rows, numbered 1 to 18. At the bottom of the window is a 'Set # Of Tests' button and a 'Ready' status bar.

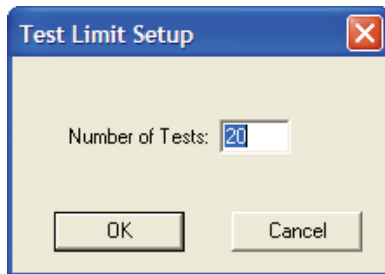
2. Enter the header information in the top section. You can use the **[Tab]** key to move from one input area to the next or you can click on the desired input area.
3. Click on the "Type:" drop-down list and select the transformer type.
4. You can set the maximum deviation percentage by clicking in the "Max. Dev. %" input area and typing in the desired value.



NOTE

When using a test plan to run the turns-ratio test, the measured turns-ratio is compared against the calculated turns-ratio. The difference (deviation) between the two turns-ratios is calculated as the percentage difference (see section 4.8.2 for the formula). A deviation greater than the preset "Max. Dev. %" will be marked as "F" (Fail) in the "P/F" column.

5. To set the test voltage, click on the “Voltage:” drop-down list and select the desired test voltage (8 Vac, 40 Vac, or 100 Vac).
6. Enter the “H Voltage”, “H Tap”, “X Voltage”, and “X Tap” values for the first row by clicking on each cell and then typing the value. You can also click on a cell, enter the value, and then press the **[TAB]** key to move to the next cell on the right. You can also use the up and down arrow keys to move vertically. Once the “H Voltage” and “X Voltage” values have been entered, the calculated ratio will be displayed in the “Calc. Ratio” column.
7. You can set the number of tests in the test plan by clicking on the “Set # of Tests” button. The following window will be displayed:



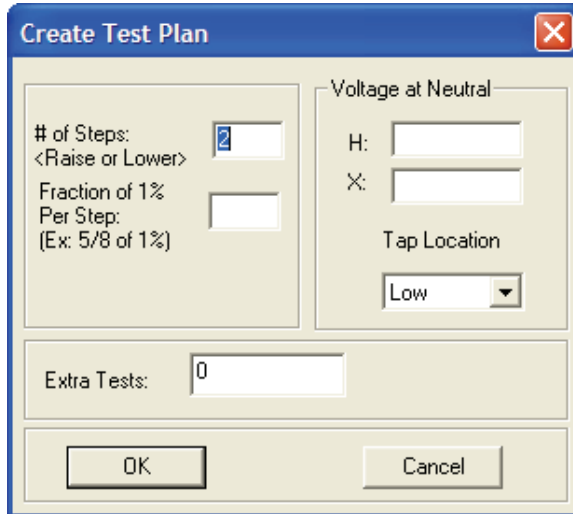
Enter the number of tests, and then click on the “OK” button. This number will determine the number of tests (data rows) in the blank test plan.

8. Once all information has been entered, save the test plan (see section 5.4).

5.8.2. Creating a Test Plan for a Load Tap Changer

To create a test plan for a load tap changer (LTC):

1. From the **Test-Plan** menu or the **File** menu, click on *Create Test Plan*, and then click on *Load Tap Changer*. The following window will be displayed:



The screenshot shows a 'Create Test Plan' dialog box. It has a title bar with a close button. The main area is divided into two columns. The left column contains three input fields: '# of Steps: <Raise or Lower>' with a value of 2, 'Fraction of 1% Per Step: (Ex: 5/8 of 1%)' which is empty, and 'Extra Tests:' with a value of 0. The right column contains a section titled 'Voltage at Neutral' with two input fields 'H:' and 'X:', and a 'Tap Location' dropdown menu set to 'Low'. At the bottom are 'OK' and 'Cancel' buttons.

2. Enter the number of steps in the corresponding input box. This is the number of taps above or below the neutral position of the tap changer. The test plan generated will have this number of steps above and below neutral. The total number of steps will be twice this number plus one (neutral).
3. Enter the fraction of 1% per step value in the corresponding input box. This defines how each step voltage is raised or lowered. The value must be entered as a fraction.
4. Enter the H voltage at neutral. This is the high side voltage at neutral.
5. Enter the X voltage at neutral. This is the low side voltage at neutral.
6. Select the LTC tap location from the corresponding drop-down list. Select "Low" if the LTC taps are located on the low side of the transformer winding. Select "High" if the LTC taps are located on the high side of the transformer winding.
7. Enter the number of extra tests. This adds extra tests other than the ones automatically generated by the TTRA program. An extra row will be added in the test plan for each extra test.

8. Click on the “OK” button. An untitled test plan with the selected parameters will be created and displayed as shown below:

Transformer Turns Ratio Analyzer Software Rev 12.6 - [Untitled Test Plan #1]

File Print Save Window

Date: Jul 06, 2009 Device: Load Tap Changer
 Time: 10:50 AM
 Company:
 Location:
 Circuit:
 Operator:
 Comment:

MFR:
 Model:
 Rating:
 Type: Single Phase (1ph0)
 Serial#:
 Max Dev. %: 0.5 Voltage: 40V
 Step: 5/8 of 1%

	Phase	H Voltage	H Tap	X Voltage	X Tap	Calc. Ratio	Meas. Ratio	Deviation	P/F	I[mA]	Angle	Res
1		12600		203	2R	62.2222						
2		12600		201	1R	62.6087						
3		12600		200	N	63.0000						
4		12600		199	1L	63.3962						
5		12600		198	2L	63.7975						

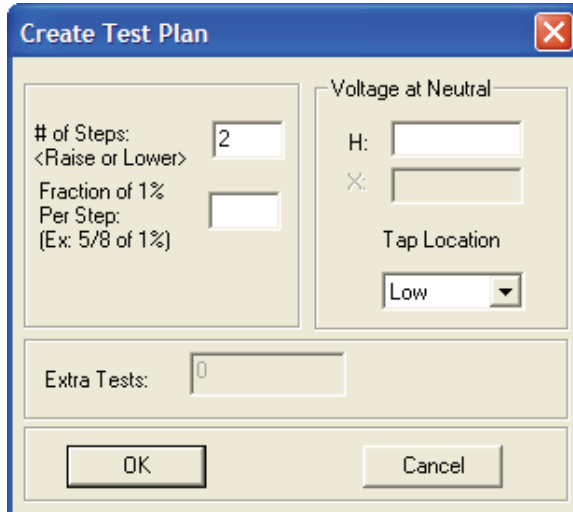
Ready

9. Enter the header information in the corresponding input fields.
10. If you had entered a number other than 0 for additional tests, enter the values for each additional test row (H Voltage, X Voltage, H Tap, and X Tap). You can also modify any of the H Voltage, H Tap, X Voltage, and X Tap values in the other rows by clicking on the corresponding cell and entering the new value.
11. Select the LTC type from the “Type:” drop-down list.
12. Enter the maximum deviation percentage in the “Max Dev. %” input field.
13. Select the test voltage from the “Voltage:” drop-down list.
14. Save the test plan (see section 5.4).

5.8.3. Creating a Test Plan for a Voltage Regulator

To create a test plan for a voltage regulator:

1. From the **Test-Plan** menu or the **File** menu, click on *Create Test Plan*, and then click on *Voltage Regulator*. The following window will be displayed:



The screenshot shows a 'Create Test Plan' dialog box. It has a title bar with a close button. The main area is divided into two columns. The left column contains three input fields: '# of Steps: <Raise or Lower>' with a value of 2, 'Fraction of 1% Per Step: (Ex: 5/8 of 1%)' with an empty field, and 'Extra Tests:' with a value of 0. The right column contains a section titled 'Voltage at Neutral' with two input fields: 'H:' and 'X:', and a 'Tap Location' dropdown menu set to 'Low'. At the bottom are 'OK' and 'Cancel' buttons.

2. Enter the number of steps in the corresponding input box. This is the number of taps above or below the neutral position of the voltage regulator. The test plan generated will have this number of steps above and below neutral. The total number of steps will be twice this number plus one (neutral).
3. Enter the fraction of 1% per step value in the corresponding input box. This defines how each step voltage is raised or lowered. The value must be entered as a fraction.
4. Enter the H voltage at neutral. This is the high side voltage at neutral.
5. Select the voltage regulator tap location from the corresponding drop-down list. Select "Low" if the voltage regulator taps are located on the low side of the transformer winding. Select "High" if the voltage regulator taps are located on the high side of the transformer winding.

- Click on the “OK” button. An untitled test plan with the selected parameters will be created and displayed as shown below:

Transformer Turns Ratio Analyzer Software Rev 12.6 - [Untitled Test Plan #1]

File Print Save Window

Date: Jul 06, 2009 Device: Voltage Regulator
 Time: 10:53 AM
 Company:
 Location:
 Circuit:
 Operator:
 Comment:

MFR:
 Model:
 Rating:
 Type: Single Phase (1ph0)
 Serial#:
 Max Dev. %: 0.5 Voltage: 40V
 Step: 5/8 of 1%

	Phase	H Voltage	H Tap	X Voltage	X Tap	Calc. Ratio	Meas. Ratio	Deviation	P/F	I[mA]	Angle	Res
1		12600		12758	2R	0.9877						
2		12600		12679	1R	0.9938						
3		12600		12600	N	1.0000						
4		12600		12521	1L	1.0063						
5		12600		12443	2L	1.0127						

Ready

- Enter the header information in the corresponding input fields.
- Select the voltage regulator type from the “Type:” down-down list.
- Enter the maximum deviation percentage in the “Max Dev. %” input field.
- Select the test voltage from the “Voltage:” drop-down list.
- Save the test plan (see section 5.4).

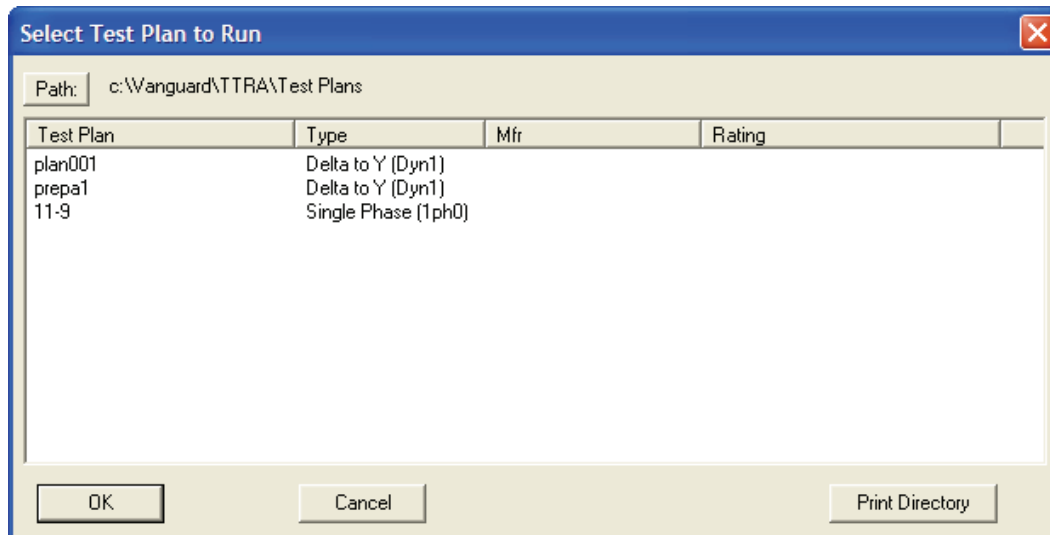
6.0 RUNNING TESTS

The TTRA software can be used to run transformer, load tap changer, and voltage regulator tests directly from the PC. This is especially convenient when used in conjunction with a test plan.

6.1 Running a Transformer Turns Ratio Test Using a Test Plan

Follow the steps below to perform a transformer turns ratio test using a test plan (the same procedure also applies for performing load tap changer and voltage regulator tests):

1. Connect the ATRT to the PC via the RS-232C port and put it in Computer Interface Mode (see section 3.3).
2. Connect the H and X leads per the ATRT's User's Manual.
3. Click on the **Test-Xfmr** menu and select *Run Test Plan...* The following window will be displayed:



- If the test plan you would like to use is not in the current directory, click on the “Path:” button at the top of the window and browse to the directory containing the file. Once you have located the test plan to be used, click on the filename, and then click on the “OK” button. The test plan will be loaded and the first test (first data row) will be selected as shown below:

The screenshot shows the 'Transformer Turns Ratio Analyzer Software Rev 12.6 - [Untitled Test Results #1]' window. The interface includes a menu bar (File, Print, Save, Window) and a toolbar. The main area is divided into two sections: a left sidebar for test parameters and a right section for test results and controls.

Test Parameters (Left Sidebar):

- Date: Jul 07, 2009
- Time: 08:19 AM
- Company: Vanguard
- Location: SHOP
- Circuit: (empty)
- Operator: HN
- Comment: (empty)

Transformer Details (Right Section):

- MFR: GE
- Model: (empty)
- Rating: 5kVA
- Type: Delta to Y (Dyn1)
- Serial#: (empty)
- Max Dev. %: 0.5
- Voltage: 40V

Test Results Table:

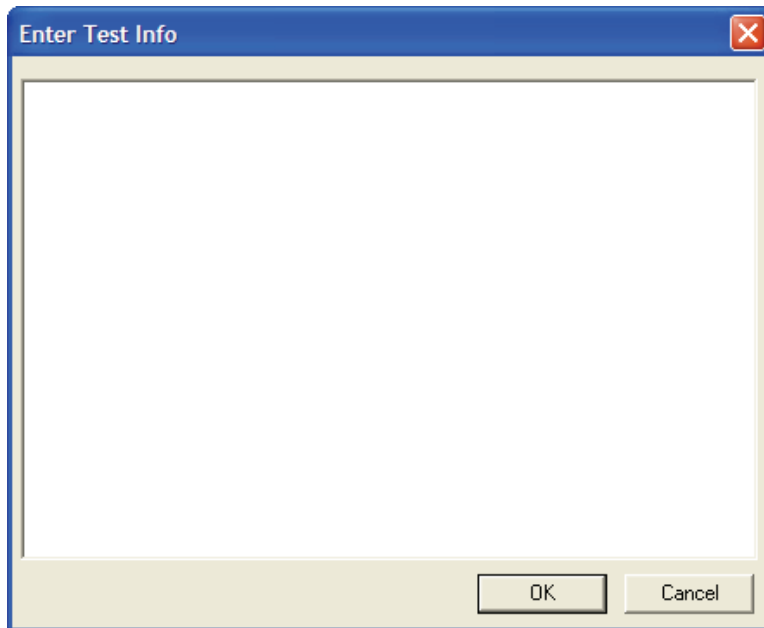
	Phase	H Voltage	H Tap	X Voltage	X Tap	Calc. Ratio	Meas. Ratio	Deviation	P/F	I[mA]	Angle	Res
1	A H1-H3/X1-X0	230000	1	115000		3.4641						
	B H2-H1/X2-X0											
	C H3-H2/X3-X0											
2	A H1-H3/X1-X0	230000	2	115500		3.4491						
	B H2-H1/X2-X0											
	C H3-H2/X3-X0											
3	A H1-H3/X1-X0											
	B H2-H1/X2-X0											
	C H3-H2/X3-X0											
4	A H1-H3/X1-X0											
	B H2-H1/X2-X0											
	C H3-H2/X3-X0											
5	A H1-H3/X1-X0											
	B H2-H1/X2-X0											
	C H3-H2/X3-X0											
6	A H1-H3/X1-X0											
	B H2-H1/X2-X0											
	C H3-H2/X3-X0											

Controls (Bottom):

- Run Test
- Next Test
- Repeat Test
- Notepad

- To run a test, click on the “Run Test” button at the bottom of the window. The TTRA will initiate the test. Once the test is finished, the measured turns ratio, excitation current, and the phase angle measurement information will be filled in. If the test plan contained the transformer’s nameplate voltages, the “percentage deviation” and “P/F” columns will also be filled in.
- You can enter the resistor value for each phase reading by clicking on the “Res” cell and entering the value.
- The header information can also be edited as needed.
- You can perform the next test by clicking on the “Next Test” button. If you would like to repeat the last test performed, click on the “Repeat Test” button.

9. A notepad is also available for entering any relevant information about the test. To access the notepad, click on the “Notepad” button. The following window will be displayed:



Type your notes and then click on the “OK” button.

10. Once all tests have been performed, click on the **File** menu and select either *Save* or *Save As...* to save the test record.

6.2 Running a Transformer Test Using the Create Test Option

The *Create Test* option from the **Test-Xfmr** menu can be used to quickly create a test plan for running a test. To test a transformer using the *Create Test* option:

1. From the **Test-Xfmr** menu, click on *Create Test* and then select *Transformer*.



NOTE

You can also select *Load Tap Changer* or *Voltage Regulator* to create a Load Tap Changer or Voltage Regulator test respectively. You will then be asked for the relevant parameters for the test. Please see sections 5.8.2 and 5.8.3.

An untitled test plan will be displayed as shown below:

	Phase	H Voltage	H Tap	X Voltage	X Tap	Calc. Ratio	Meas. Ratio	Deviation	P/F	I[mA]	Angle	Res
1	H1-H2/X1-X2											
2	H1-H2/X1-X2											
3	H1-H2/X1-X2											
4	H1-H2/X1-X2											
5	H1-H2/X1-X2											
6	H1-H2/X1-X2											
7	H1-H2/X1-X2											
8	H1-H2/X1-X2											
9	H1-H2/X1-X2											
10	H1-H2/X1-X2											
11	H1-H2/X1-X2											
12	H1-H2/X1-X2											
13	H1-H2/X1-X2											
14	H1-H2/X1-X2											
15	H1-H2/X1-X2											
16	H1-H2/X1-X2											
17	H1-H2/X1-X2											
18	H1-H2/X1-X2											

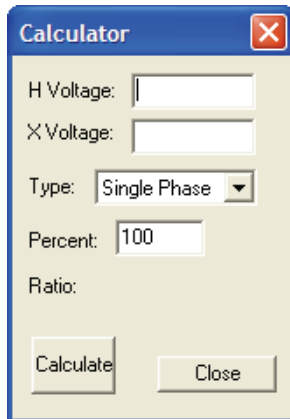
2. Fill in the header information.
3. Select the transformer type from the “Type:” drop-down list.
4. Edit the Max. Dev. % value if necessary.
5. Select the test voltage from the “Voltage:” drop-down list.
6. Fill in the transformer nameplate voltages. The “Phase” and “Calc. Ratio” fields will be filled in automatically.
7. Click on the “Run Test”, “Next Test” or “Repeat Test” button to test the transformer.

8. Once all tests have been performed, click on the **File** menu and select either *Save* or *Save As...* to save the test record.

7.0 USING THE TRANSFORMER TURNS RATIO CALCULATOR

The TTRA software features a turns ratio calculator that can be used to quickly calculate the winding turns ratio of a transformer. To use the calculator:

1. Click on the **File** menu and select *Calculator*. The calculator window will be displayed as shown below:



2. Type the H voltage and X voltage values in the corresponding fields.
3. Select the transformer type from the “Type:” drop-down list.
4. If desired, type a percentage value in the “Percent:” input field. This option calculates the turns ratio at the specified percentage of the nameplate voltage. For example, if the H nameplate voltage is 12,000V, the X nameplate voltage is 1200V, the transformer type is single phase, and the percentage value of 80 is used, the turns ratio will be calculated as:

$$\begin{aligned}\text{Ratio} &= (V_H / V_X) \times (\text{Percent} / 100) \\ &= (12,000 / 1200) \times (80 / 100) \\ &= \mathbf{8.00}\end{aligned}$$

5. Click on the “Calculate” button and the calculated ratio will be displayed to the right of the “Ratio:” label.



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